

REMARKS

In view of the above amendments and arguments herein, Applicants believes the pending application is in condition for allowance.

I. Status of the Claims

Claims 14 - 28 and 41 - 48 are currently pending, with claims 1 - 13, 29 - 40 and 49 - 54 having previously been cancelled. In the present Response, Applicants cancel claim 15 without prejudice or disclaimer, and amend independent claim 14 to essentially include the elements of cancelled claim 15. Applicants also amend independent claim 23, and add new claims 55 - 57. No new matter is introduced. Support may be found in Applicants' specification, for example, at page 64, line 22 through page 65, line 4 and page 70, line 21 through page 71, line 3.

II. Rejections under 35 U.S.C. §112

Claims 23 - 28 are rejected under the second paragraph of 35 U.S.C. § 112 as failing to set forth the subject matter that Applicants regard as their invention. Specifically, the Examiner finds that the language of claim 23 calling for “applying the roughened surface of the soft solder alloy surface reforming treatment that calls for forming a layer containing fluorine on the surface of the soft solder alloy” is indefinite.

Applicants amend this claim language to read “applying a surface reforming treatment to form a layer containing fluorine on the roughened surface of the soft solder alloy;” submit that the amended claim language is definite, and respectfully request that the rejection of claims 23 - 28 under the second paragraph of 35 U.S.C. § 112 be withdrawn.

III. Rejections under 35 U.S.C. §102

Claims 14, 15, 17 and 20 - 22 are rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,000,819 to Pedder et al. ("Pedder"). Applicants cancel claim 15 without prejudice

or disclaimer, amend independent claim 14 to essentially include the elements of cancelled claim 15, and respectfully traverse this rejection.

In amended claim 14, Applicants claim:

14. A solder bump forming apparatus adapted to use a soft solder alloy on the surface of a workpiece to form solder bumps, which will serve as connecting terminals, said solder bump forming apparatus including:

a plasma generating means adapted to generate at least hydrogen-containing plasma under a low pressure, the plasma generating means being provided with:

a high frequency power supply and an electrode connected to said high frequency power supply and adapted to generate plasma, said electrode having: a hollow electrode body adapted to receive a process gas,

supply openings that are adapted to feed the process gas and bored in the end of the electrode body facing away from the workpiece, and

through holes bored through the electrode body so as to extend from the end where the supply openings are formed to the opposite end;

a gas supply means for feeding process gas to the plasma generating means;

a workpiece exposing means for exposing the soft solder alloy on the surface of the workpiece at least to hydrogen-containing plasma; and

a heating means for applying a reflow treatment the soft solder alloy in a vacuum.

(Emphasis added).

Pedder discloses a dry solder reflow process which removes metal surface oxides from the solder surface by abstraction of the oxygen from the metal oxide by atomic hydrogen generated in a microwave plasma of hydrogen gas (see, e.g., abstract of Pedder). Pedder teaches that a suitable plasma may be generated by a 200 watt, 2.45 GHz microwave generator operating in a small tunable microwave cavity that generates a gas flow flowing through a conical section and an

“earthed microwave shield in the form of a perforated plate” toward a workpiece (see, e.g., Col. 3: 35- 56).

Applicants’ amended independent claim 14 claims a plasma generating means that includes an electrode having a hollow electrode body, supply openings that are adapted to feed the process gas and that are bored in the end of the electrode body to face away from the intended workpiece, and through holes bored through the electrode body to extend from the end at which the supply openings are formed to the opposite end (see, e.g., electrode 22 in Applicants’ FIGs. 1A, 1B).. Applicants respectfully disagree with the Examiner’s characterization that the claimed electrode differs from the microwave shield of Pedder only with regard to “intended use.”

In sharp contrast to the microwave shield disclosed by Pedder, Applicants’ claimed electrode includes a hollow body for receiving supply gas and supply openings which are bored into an end surface of the hollow body and through holes which extend through the hollow body from the end surface at which the supply openings are provided through to a surface at an opposite end (see, e.g., page 25, line 9 through page 26, line 6 of Applicants’ specification). Pedder’s disclosed microwave shield fails to include or suggest each of the claimed elements in Applicants’ electrode.

The claimed elements in Applicants’ electrode perform a unique function. Plasma ions generated in the supply gas within the electrode are ejected through the supply openings, which are located in an end surface of the electrode that faces away from the workpiece. The through holes serve as “H tunnels” for trapping the plasma ions as they pass into the through holes after exiting the supply openings. This trapping prevents a violent collision of ions with the workpiece, thereby protecting a passivation film and/or other components of the workpiece from damage (for example, physical etching caused by collisions with the ions). This enables active species that are generated during the plasma reaction to pass through the through holes to etch the workpiece by means of a soft, chemical reaction (see, e.g., page 27, line 16 through page 28, line 12 of Applicants’ specification).

IV. Rejections under 35 U.S.C. §103

Claims 16 and 18 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Pedder in view of U.S. Patent No. 5,409,543 to Panitz et al. ("Panitz"). Claim 19 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Pedder in view of U.S. Patent No. 5,345,056 to Frei et al. ("Frei"). Applicants respectfully traverse these rejections.

Claims 24 and 25 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Todd in view of Frei. Claims 26 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Todd in view of Frei and Panitz. Claims 27, 28, 42, 44 and 47 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Todd in view of U.S. Patent No. 4,921,157 to Dishon et al. ("Dishon"). Claims 45 and 48 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Todd in view of Dishon and U.S. Patent No. 1,437,641 to Ferriere et al. ("Ferriere"). Applicants respectfully traverse these rejections.

Claims 16, 18 and 19 each depend from allowable claim 14. Claims 24 - 28 each depend from allowable claim 23. Claim 42 depends from allowable claim 41. Claims 44 and 45 each depend from allowable claim 43. Claims 47 and 48 depend from allowable claim 46. For at least these reasons, Applicants respectfully submit that dependent claims 16, 18, 19, 24 - 28, 42, 44, 45, 47 and 48 are also allowable.

Applicants therefore respectfully request that the rejections of claims 16, 18, 19, 24 - 28, 42, 44, 45, 47 and 48 under 35 U.S.C. § 103(a) be withdrawn.

V. New Claims

Applicants add new claims 55 - 57. As new claims 55 - 57 respectively depend from allowable claims 23, 43 and 46, Applicants respectfully submit that new claims 55 - 57 are allowable for at least this reason.

CONCLUSION

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

If there are any other issues remaining which the Examiner believes could be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the telephone number indicated below.

Dated: March 27, 2007

Respectfully submitted,

By Thomas J. Bean
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